CHAPTER 26

NOISE BARRIERS

26.1 General

The necessary information for design of Noise Barriers will include the following:

- Types of noise barriers to be used
- Required height, length and offset for noise abatement
- Architectural treatments

The Designer shall identify and verify all existing utility conduits in the vicinity of the proposed noise barrier wall alignment. If any existing utility interferes with the noise barrier, the affected utility shall be contacted for possible relocation of the existing utility conduits. **The AASHTO Guide Specifications for the Structural Design of Sound Barriers** shall be used at this time. The allowable stress design method (working stress design method) shall be used for all components of noise barriers. Design criteria, not specifically herein addressed, shall conform to applicable Sections of the **AASHTO Standard Specifications for Highway Bridges**, with current interims as modified by this Manual.

The following Tables, 26-A through 26-D, as obtained from the **AASHTO Guide Specifications for the Structural Design of Sound Barriers** have been converted to metric units. They should be referred to for verification of the design category.

Table 26-A:
Minimum Wind Pressure On Sound Barriers Located In Coastal Regions

Distance From Average Level Of Adjoining Ground Surface To Centroid Of Loaded Area In Each Height Zone, Feet	Cc	Minimum Pressure (P), PSF For The Indicated Wind Velocity (V), mi/Hour			
		80	90	100	110
0 < H≤ 14	1.20	40	50	62	75
14 < H ≤ 29	1.37	45	58	70	87
Greater Than 29	1.49	50	63	77	94

Table 26-A is to be used for both ground mounted and structure mounted noise barriers in flat unobstructed areas exposed to wind flowing over large bodies of water and extending inland from the shoreline a distance of ½ mi.

Table 26-B:
Minimum Wind Pressure On Sound Barriers Located On Bridge Structures, Retaining Walls, or Traffic Barriers

Distance From Average Level Of Adjoining Ground Surface To Centroid Of Loaded Area In Each Height Zone, Feet.	Cc	Minimum Pressure (P), PSF For The Indicated Wind Velocity (V), mi/Hour			
		80	90	100	110
0 < H≤ 14	0.80	27	34	42	49
14 < H ≤ 29	1.00	33	42	52	63
Greater Than 29	1.10	37	46	57	69

Table 26-B is to be used in open terrain with scattered obstructions. This includes flat, open country and grasslands. This exposure shall be used for all sound barriers located on bridge structures, retaining walls or traffic barriers that are not covered by Table 26-C.

Table 26-C:
Minimum Wind Pressures On Sound Barriers Not Located On Structure
(Open Terrain)

Distance From Average Level Of Adjoining Ground Surface To Centroid Of Loaded Area In Each Height Zone, Feet.	Cc	Minimum Pressure (P), PSF For The Indicated Wind Velocity (V), mi/Hour			
		80	90	100	110
0 < H≤ 14	0.59	20	25	31	37
14 < H ≤ 29	0.75	25	32	39	47
Greater Than 29	0.85	28	36	44	53

Table 26-C is to be used in urban and suburban areas with open terrain that does not meet the requirements of Table 26-D. Generally, this Table should be used for ground mounted noise barriers.

Table 26-D:
Minimum Wind Pressure On Sound Barriers Not Located On Structures
(Urban and Suburban Areas)

Distance From Average Level Of Adjoining Ground Surface To Centroid Of Loaded Area In Each Height Zone, Feet.	Cc	Minimum Pressure (P), PSF For The Indicated Wind Velocity (V), mi/Hour			
		80	90	100	110
0 < H≤ 14	0.37	12	16	19	23
14 < H ≤ 29	0.59	17	21	26	31
Greater Than 29	0.59	20	25	31	37

Table 26-D is to be used in urban and suburban areas with numerous closely spaced obstructions having the size of single-family dwellings or larger that

prevail in the upwind direction from the noise wall for a distance of at least 1500 ft. Wind loads shall be applied perpendicular to the wall surface.

Adjacent ground surface can be defined as the ground elevation (or water elevation) immediately adjacent to the structure. In situations where noise barriers are mounted on bridges and retaining walls, the height to be utilized in determining the design wind pressure, P, shall be taken from the lowest average ground or water elevation adjacent to the noise barrier, to the centroid of the loaded area.

The following are load groups to which the noise barriers may be subjected. Each part of the structure shall be proportioned for the load combinations.

- Dead Loads
- Wind Loads
- Seismic Loads
- Impact Loads
- Ice and Snow Loads

The **AASHTO Standard Specifications for Highway Bridges** shall be used to determine these loading conditions. The following information for Seismic Loads as well as the **AASHTO Standard Specifications for Highway Bridges** shall be referenced in considering the Seismic load combination.

26.2 Seismic Loads

When seismic loads have to be considered in load combination, the Designer shall refer to the **AASHTO Standard Specifications for Highway Bridges** and **AASHTO Guide Specifications for Structural Design of Sound Barriers**

The seismic dead load shall consist of the weight of all the component materials making up the noise barrier, excluding the foundation. The point of application of the Seismic Dead Load, EQD, of the individual components shall be at their respective centers of gravity.

When a noise barrier is supported by a bridge superstructure, the wind or seismic load to be transferred to the superstructure and substructure of the bridge shall be as specified within this chapter of this manual. Additional reinforcement may be required in traffic barriers and overhangs to resist the loads transferred by the noise barrier.

26.3 Functional Requirements

- Guiderail or concrete barrier curb shall be used when the noise barrier is located within the clear zone.

- Stopping sight distance criteria shall apply in determining the location of a noise barrier. Horizontal clearances that reduce the stopping sight distance shall be avoided. In those extreme cases where reduced stopping sight distances may be warranted, a design exception shall be provided to justify the need.
- Minimum Height - Noise barriers should have a minimum height consistent with that of a ROW fence (measured from the top of the barrier to the ground). Height requirements will be determined by noise studies performed by DDOT. When the tops of noise walls have to be stepped, the maximum height of step should not exceed 24 in.

When noise barriers higher than 16 ft. 6 in. are required by sound studies performed by consideration of surrounding features, they should be evaluated such that an exceptionally high wall does not create an unsightly impact on the environmental aesthetic features of the territory. In such situations, noise barriers in combination with earth mounds should be considered.

- Barriers can obstruct light as well as noise. Special consideration shall be given to possible roadway icing and other induced environmental conditions caused by the placement of the wall.
- It is important to have drainage facilities along noise barriers to assure soil stability. Soil with phi (ϕ) of 25 degrees or less may develop flowing characteristics when saturated. Surface runoffs should be directed away from the noise barrier.
- Provisions may be necessary to allow fire fighters and chemical spill cleanup crews access to fire hydrants on the opposite side of the noise barrier. The designer should consult with local fire and emergency officials regarding their specific needs.
- For noise barriers that must bridge over conduits, provisions should be made to accommodate differential settlement in the noise walls substructures.
- The Preliminary Submission for Noise Barriers shall include a Report to address the possibility of icing, the storage of snow, utilities impact, drainage, and mounting on culverts.

26.4 Maintenance Considerations

- Noise barriers placed within the area between the shoulder and ROW line may complicate the ongoing maintenance and landscaping operations, especially if landscaping is placed on both sides of the noise barrier. Special considerations should be given to maintaining the adjoining land behind the noise barrier and adjacent to the ROW line. A minimum 3 to 6 ft. wide shrub planting area between the proposed guiderail and the noise barrier might be considered.
- In some urban areas, noise barriers may be subjected to graffiti being placed on their surfaces. In these locations, the surface texture selected should be such that it is difficult to place the graffiti or such that the graffiti is easily

removed. Noise barriers with rough textures and dark colors tend to discourage graffiti.

- Access to the backside of the noise barrier should be provided for inspection, litter control, soil erosion monitoring, grass mowing and maintenance. In subdivision areas, access may be via local streets, when available. If access is not available via local streets, access gates or openings are essential at intervals along the noise barrier. Offset barriers concealing the access opening must be overlapped a minimum of 4 times the offset distance in order to maintain the integrity of the noise attenuation of the main barrier. Location of the access openings should be coordinated with the appropriate agency or landowner. Gates in the noise barriers along federal aid routes require justification and FHWA approval.

26.5 Noise Barriers on Bridges

- Provisions for expansion shall be placed in the noise barrier at locations of bridge deck expansion joints and at parapet deflection joints.
- For noise barrier retrofit onto existing bridges, the Designer must verify that the dead and live load from the wall do not overstress any component of the bridge including the existing parapets, slab overhang, girders and superstructure members.
- The dead load of noise barriers can affect the overload capacity and deflection of some bridges. Check the change in load capacity of the bridge and verify whether the change is acceptable.

26.6 Types of Barriers

Timber or precast, prestressed, reinforced, concrete post and panel systems are preferred; however, if unusual site conditions prohibit the use of a post and panel system, another noise barrier type may be considered (such as aluminum for bridges). Determination of the type of barrier and architectural treatments to be used at a site prior to the design of the barrier will be made by the Department. The Designer shall obtain the necessary information regarding barrier type and architectural treatments from the Department and shall refine and incorporate this information into the design. Example considerations of noise barrier architectural treatments:

- Flush posts and panels on the traffic face of the barrier to provide a smooth appearance to motorists.
- Coloring of the surfaces by tinting, staining or other methods.
- End treatments
- Sloping transitions (rather than stepped transitions)
- Planting pockets
- Meandering barriers (posts and panels not arranged in a straight line, parallel to the centerline of the roadway).

- Caps on top of the barriers to provide horizontal continuity.

In most cases, foundations for noise barriers shall be drilled shafts; however, in cases where shallow rock formations exist, spread footings will be unavoidable. Noise barriers on bridges shall be mounted on the parapets or attached directly behind the parapet.

In a retrofit or rehabilitation situation, where it is determined that the existing or rehabilitated structure cannot accommodate the noise barrier loading, a separate supporting structure for the noise barrier may be considered. Sound leakage between the parapet and noise barrier shall be prevented by the use of flashing or other mechanical means.

A number of proprietary sound barrier systems are available. Proprietary wall systems shall be approved prior to the design of the barrier.

26.6.1 Materials

Concrete for cast in place foundations and precast/prestressed posts and panels shall conform to the DDOT standards. Reinforcing steel shall conform to Subsection 915.01 of the DDOT standards, Grade 60, fs =24,000 psi.

Welded wire fabric fabricated from deformed wire may be substituted for reinforcing bars. Refer to the DDOT standards for additional criteria concerning the use of welded wire fabric reinforcement.

The provision of corrosion-protected reinforcement shall be as determined on a project-by-project basis. The location of the noise barrier panels, in relationship to the offset distance from the roadway, shall be evaluated to determine if provision of corrosion-protected reinforcement is warranted. If the location of the noise barrier panels may subject the panels to splashing from the roadway surface, provision of corrosion-protected reinforcement, should be recommended. In such cases, the bottom one-third height of the panels should be scheduled for placement of corrosion-protected reinforcement.

Glued laminated timber material is preferred for construction of timber noise barriers. Glued laminated timber material shall be classified as 22F-E5 DF/DF (Douglas Fir) or 20F-E3 SP/SP (Southern Pine).

Design values can be obtained from tables within **AITC (American Institute of Timber Construction) Publication 117 entitled "Design Standard Specifications for Structural Glued Laminated Timber for Softwood Species"** or the **NDS (National Design Specification) Supplement by the National Forest Products Association.**

The tables within these documents provide allowable stresses for different species and grades of glued laminated timber. These tables are an expanded version of what is provided in **AASHTO Division I, Section 13.** Wet-use factors of 0.8 for bending and 0.875 for shear shall be applied to the minimum allowable stresses. When the depth of the beam in the plane of bending exceeds 12 in., a size factor shall be applied. Refer to the current article within **AASHTO Division I, Section 13** for more information.

Allowable stresses for aluminum shall conform to the current edition of the **Aluminum Association Specifications for Aluminum Structures**. The allowable stresses pertaining to bridge structures shall be utilized.

26.6.2 Foundation Design

The method of design for drilled shaft foundations shall be approved, or as directed, by the Geotechnical Engineering. The lateral load determined by the controlling Group Load Case shall be multiplied by a factor of 2 to obtain F, the applied lateral load. The intent of this procedure is to maintain a factor of safety of 2 against overturning. The allowable overstress should not be applied to the allowable soil strength.

26.6.2.1 Special Requirements for Sloped Soil Conditions

As stated in **Appendix C, Part B of the AASHTO, Guide Specifications for the Structural Design of Sound Barriers**, a level ground condition is defined as one in which the ground surface is approximately level or, when sloping down and away from the drilled shaft foundation, is not steeper than 1:10 (V: H) for phi (ϕ) = 35 degrees or 1:14 (V: H) for phi (ϕ) = 25 degrees. When these conditions prevail within a distance of two times the drilled shaft foundation embedment, the ground may be considered level, regardless of steeper slopes outside these limits.

Drilled shafts located in slopes shall be protected by a berm. The berm shall be level and provide a minimum cover of 12 in. over the drilled shaft. It shall extend a minimum of 12 in. beyond the face of the drilled shaft. Sloped soil conditions shall be taken into account when computing the required embedment length for drilled shaft foundations. The method of design shall be approved, or as directed, by the DDOT Geotechnical Engineering Unit.

NOTE: A foundation report shall be submitted for noise barriers.